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NATIONAL PROGRAM OF INSPECTION OF NON-FEDERAL DAMS. TENNESSEE. --ETC(U)
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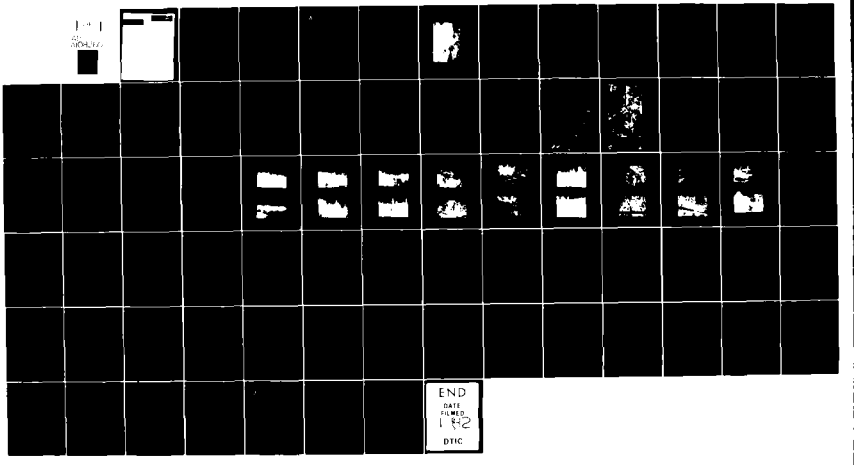

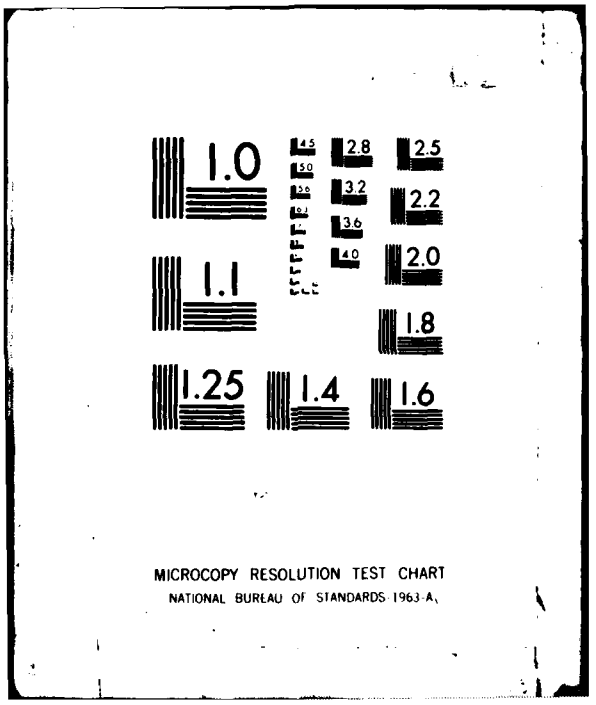
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REPORT DOCUMENTATION PAGE	READ INSTRUCTIONS BEFORE COMPLETING FORM
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4. TITLE (and Subtitle) National Program of Inspection of Non-Federal Dams, Tennessee. Akers Dam (Inventory Number TN 16503) near Turners Station, Tennessee, Sumner County, TN Barren River Basin	5. TYPE OF REPORT & PERIOD COVERED Phase 1 Investigation Report
	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s)	8. CONTRACT OR GRANT NUMBER(s) DACW62-81-C-0056
9. PERFORMING ORGANIZATION NAME AND ADDRESS Tennessee Department of Conservation Division of Water Resources 4721 Trousdale Dr., Nashville, TN 37220	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
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Dams
Dam Safety
National Dam Safety Program
Akers Dam, TN
Turners Station, TN
Sumner County, TN.
Embankments
Visual Inspection
Structural Analysis

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Akers Dam intercepts a small unnamed tributary of Little Trammel Creek about one mile southeast of the Turners Station Community in Sumner County. The crest of the 26 foot high, earthfilled embankment is 11 feet wide and 280 feet long. The upstream slope is approximately 1V:1.4H and the downstream slope varies from 1V:1.5H to 1V:2.5H. The stability of the downstream face is questionable due to the steep slopes, extensive seepage, and emergence of the phreatic surface high on the downstream face. The reservoir discharges through a 23 foot wide saddle service/emergency spillway that is 150 feet long and

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located on the left abutment. Hydraulic analysis revealed the spillway to be marginally adequate to pass the 1/2 PMF which is the design storm specified by the guideldnes of the Office of the Chief of Engineers (OCE) for a dam in the the small size and high hazard potential categories. At this time, the dam is considered "unsafe-nonemergency". It is recommended that a qualified engineer be engaged immediately to determine modifications necessary for improving slope stability, seepage control, and determining condition of the drawdown drain along with moving the drawdown drain to the upstream end.

DEPARTMENT OF THE ARMY
NASHVILLE DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1070
NASHVILLE, TENNESSEE 37202

25 SEP 1981

IN REPLY REFER TO
ORNED-G

Honorable Lamar Alexander
Governor of Tennessee
Nashville, TN 37219

Dear Governor Alexander:

Furnished herewith is the Phase I Investigation Report on Akers Dam near Turners Station, Tennessee. The report was prepared under the authority and provisions of PL 92-367, the National Dam Inspection Act, dated 8 August 1972.

The report presents details of the field inspection, background information, technical analyses, findings, and recommendations for improving the condition of the dam.

Based upon the inspection and subsequent evaluation, Akers Dam is classified as unsafe-nonemergency due to insufficient spillway capacity to safely pass the one-half probable maximum flood, questionable stability of the downstream slope, and extensive seepage through the embankment.

We do not consider this an emergency situation at this time, but the recommendation concerning project modifications to allow safe passage of the design flood and others contained in this report should be undertaken in the near future to minimize the risks to the residences located downstream.

Public release of the report and initiation of public statements fall within your prerogative. However, under provisions of the Freedom of Information Act, the Corps of Engineers is required to respond fully to inquiries on information contained in the report and to make it accessible for review on request.

Your assistance in keeping me informed of any further developments will be appreciated.

Sincerely,

LEE W. TUCKER
Colonel, Corps of Engineers
Commander

1 Incl
As stated

CF:
Mr. Robert A. Hunt, Director
Division of Water Resources
4721 Trousdale Drive
Nashville, TN 37220

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam ..... Akers

County ..... Sumner

Stream ..... Unnamed Trib. of Little Trammel Creek

Date of Inspection ..... April 15, 1981

Prepared By:

Troy A. Wedekind
Regional Engineer

Approved By:

Edmond B. O'Neill
Chief Engineer
Safe Dams Section

Approved By:

Robert A. Hunt, P.E.
Director, Division of
Water Resources
Tennessee Department
of Conservation

Akers Dam, Sumner County, Tennessee

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam ..... Akers

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ABSTRACT

Akers Dam intercepts a small unnamed tributary of Little Trammel Creek about one mile southeast of the Turners Station Community in Sumner County. The crest of the 26 foot high, earthfilled embankment is 11 feet wide and 280 feet long.

The upstream slope is approximately 1V:1.4H and the downstream slope varies from 1V:1.5H to 1V:2.5H. The stability of the downstream face is questionable due to the steep slopes, extensive seepage, and emergence of the phreatic surface high on the downstream face.

The reservoir discharges through a 23 foot wide saddle service/emergency spillway that is 150 feet long and located on the left abutment. Hydraulic analysis revealed the spillway to be marginally adequate to pass the ½ PMF which is the design storm specified by the guidelines of the Office of the Chief of Engineers (OCE) for a dam in the small size and high hazard potential categories.

At this time, the dam is considered "unsafe-nonemergency". It is recommended that a qualified engineer be engaged immediately to determine modifications necessary for improving slope stability, seepage control, and determining condition of the drawdown drain along with moving the drawdown drain to the upstream end.

TABLE OF CONTENTS

APPENDICES

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

SECTION 1 - GENERAL

1.1 Authority - The Phase I inspection of this dam was carried out under the authority of Tennessee Code Annotated, Sections 70-2501 to 70-2530, The Safe Dams Act of 1973, and in cooperation with the U. S. Army Corps of Engineers under the authority of Public Law 92-367, The National Dam Inspection Act.

1.2 Purpose and Scope - The purpose of a Phase I investigation is to develop an engineering assessment of the general condition of a dam with respect to safety and stability. This is accomplished by conducting a visual inspection, reviewing any available design and construction data, and performing appropriate hydraulic, hydrologic, and other analyses. A comprehensive description of the Phase I investigation program is given in Recommended Guidelines for Safety Inspection of Dams, Department of the Army, Chief of Engineers, Washington, D. C. 20314.

1.3 Past Inspections - An inventory survey was made on July 20, 1973, by the Tennessee Department of Conservation, Division of Water Resources. On February 4, 1980, a complete survey of the site was made by the Division of Water Resources. At this time, a preliminary inspection was made and extensive leakage around a willow tree on the downstream embankment face near the left abutment was noted.

1.4 Details of Inspection - The Phase I inspection was conducted on April 15, 1981. During the inspection the weather was sunny with a light haze with temperatures near 65°F. The reservoir surface was slightly below normal pool level with no flow through the spillway.

1.5 Inspection Team Members - The inspection was conducted by the following State personnel:

Troy A Wedekind, Regional Engineer
Robert L. Ramsey, Regional Engineer

SECTION 2 - PROJECT DESCRIPTION

2.1 Location - The dam is on a small tributary of Little Trammel Creek about one mile southeast of the community of Turners Station in the northeast corner of Sumner County. The site location is on the Turners Station, USGS, 7.5 minute quadrangle map (312SE) at north latitude 36°36'00" and west longitude 86°15'28". Location maps are provided in Appendix B (Figures 1 and 2).

2.2 History of Project - The earthfilled embankment was constructed about 1960 from the soils in the reservoir area by the present owner, Mr. William B. Akers. A local construction equipment operator, John Parker, was contracted by the owner to construct the embankment. Dozers and pans were used for the removal and placement of material but little is known concerning the method of construction. Shortly after the completion of the dam, a section of embankment was damaged from overtopping by flood flow. Although the full extent of the damage to the embankment is not known, the damage was reportedly of a relatively minor nature. The embankment was repaired and the spillway enlarged by cutting into the left abutment which was achieved by blasting the abutment rock.

2.3 Size and Hazard Classification - Based on the maximum structural height of 26 feet and a maximum storage capacity of 60.7 acre-feet, the dam is in the small size classification. The structure is classified in the high hazard potential category because three homes, old Hwy 31E, and an old barn are located within a mile downstream which could be damaged by a sudden failure of the dam.

2.4 Description of Dam and Appurtenances

2.4.1 Embankment - The dam is a linearly aligned apparently homogeneous earthfill embankment constructed of clay derived from the insitu weathering of the underlying dolomite bedrock. According to published maps, the dolomite bedrock is of the Fort Payne formation. Outcroppings observed in the area were medium gray dolomite. The dam has a maximum structural height of 26 feet and has a

crest length of 280 feet (Figures 3 and 5). The crest width varies slightly but is generally 11 feet wide (photo no. 1). The elevation across the crest varies from 820.5' msl to 818.4' msl decreasing in elevation towards the left end of the dam (Figure 4). The upstream face is generally sloped at 1V:1.4H above the water surface and continues below the water surface at roughly the same slope except for a small bench near the waterline (Figure 5). The downstream slope is non-uniform and variable along the face. The downstream slope is generally 1V:1.5H on the upper portion and varies between 2.3 and 2.5H:1V on the lower portion (Figures 5 and 6).

2.4.2 Service/Emergency Spillway - The service/emergency spillway founded on dolomite bedrock at the left abutment. The earth and rock side slopes vary down the channel between 1.6 to 2.8H:1V on the left side and between 6.1 to 8H:1V on the right side (Figure 5). Large dolomite slabs were placed on the right slope. The crest elevation at the spillway is approximately 814.9' msl. The spillway channel is roughly 150 feet long and runs perpendicular to the axis of the dam (Figures 3 and 7; photo nos. 5 and 6). Outflow from the channel cascades down the side of a natural draw to the old stream channel.

2.4.3 Drawdown Facility - Drawdown capability is provided by a 6-inch cast iron pipe with a manually operated gate valve on the downstream end of the pipe. The valve is located at the toe near the right abutment (Figure 3 and photo 7).

2.5 Downstream Channel - The natural channel is not well defined for roughly 200 feet downstream of the toe at which point surface runoff has cut a narrow meandering stream with banks up to 3 feet high.

2.6 Reservoir and Drainage Area - At normal pool, the reservoir has a surface area of roughly 5 acres and an impounding capacity of 48 acre-feet. From normal pool the flood storage capacity to the top of the dam is 12.7 acre-feet. The drainage area has 116.6 acres with moderate slopes. Most of the drainage area is wooded with some pastureland on the flatter areas.

SECTION 3 - FINDINGS

3.1 Visual Inspection

3.1.1 Embankment - The entire upstream face is covered with moderately heavy brush and small diameter deciduous trees (photo no. 2). Some trees, mainly sycamore, have diameters up to 6 inches. There was no designed slope protection with only intermittent rock along the waterline. A small berch has formed below the waterline from the slight erosion of the upstream face. No signs of structural instability were found along the upstream face.

The crest is linear and has a slightly variable width that constricts near the maximum section (photo no. 1). The crest face has a good grass cover with no signs of erosion. The crest face wavers randomly from inclining upstream to inclining downstream (photo no. 1). A slight depression (2") was noted on the crest near the maximum section. It was curved downstream giving the appearance of early stage slope failure. However, no cracks or signs of recent activity were present.

The downstream face has some briers, brush, and small trees but is mainly covered with deciduous trees between 2 and 8 inches in diameter (photo no. 3). No erosion of the downstream face was noted. The downstream slope flattened to a variable slope roughly halfway down the face. A large area of saturation was found along the left half of the dam and generally started at the change in slope and extended to the toe (photo nos. 11 and 12). Shallow, spotty sloughing was noted in the saturated area (photo nos. 9 and 10). A flow of 1 gpm was found roughly 30 feet from the left abutment and about 10 feet below the crest. The flow appeared clear but residual gravels from the embankment material were observed at the opening (photo nos. 13 and 14). Total flow from the saturated area was estimated to be 4 gpm (photo no. 17). Another small flow was found about 5 feet upstream from the drain valve. Flow was clear and less than ½ gpm (photo nos. 15 and 16). A

shallow gully was found along the right abutment embankment contact. The erosion did not appear to be very active. Soil sampling of the upstream face with a hand auger to a depth of 1.5 feet revealed a soil that was a medium brown, slightly silty, slightly sandy clay. Soil tests revealed a liquid limit of 34.8 and a plastic limit of 21.6; therefore, the soil is listed in the CL group of the Unified Soil Classification System.

3.1.2 Service/Emergency Spillway - Scattered trees are located on the base and side slopes of the spillway channel. The trees are less than 3" in diameter (photo nos. 5 and 6). The channel has two high points. One high point is near the axis of the dam and controls normal pool. The other high point is near the end of the channel and controls flood flows because of the reduction in side slopes (Figures 3 and 7). The right side slope of the channel appears to be constructed from material removed from the channel. At maximum flow the right side slope would be overtopped and would discharge along the left embankment contact.

3.1.3 Drawdown Facility - The gate valve on the downstream end of the pipe is the portion of the facility that could be seen. The outlet could not be located. A portion of the pipe revealed by hand digging appeared in good condition. The wheel for the valve had been removed and the caretaker was not certain of its location. The valve apparently has not been operated since construction.

3.1.4 Downstream Channel - The floodplain through which the natural stream passes is roughly 100 feet wide and covered with 1000 feet of open grassland, then 1000 feet of woodland, then grassland to the old highway. The stream bottom, for the most part, is rock. The stream is channeled past the houses after it passes the road (photo no. 18).

3.2 Review of Data - No data concerning design, construction, or operation are available.

3.3 Static and Seismic Stability Assessment - The calculated margin of safety for the embankment stability requires embankment and foundation data that is not available and is beyond the scope of the investigation. Consequently, embankment

stability must be based on visual evidence and engineering judgment. On this basis, the stability of the embankment is threatened due to the steep upper slopes and the extensive seepage on the lower slope. The dam is located in seismic zone 1 where seismic stability is assumed adequate provided static stability conditions are satisfied and conventional safety margins exist.

3.4 Hydraulic and Hydrologic Analysis - According to OCE guidelines, the minimum design storm for a dam in the small size and significant hazard categories is the ½ PMF. Hydraulic analysis indicated that under antecedent moisture condition III (AMC III) flow from the ½ PMF will not overtop the main embankment but will overtop the right spillway and flow down the embankment contact with the abutment. Flow duration will be about 30 minutes with a depth of approximately 1 foot. The PMF AMC II event will overtop the embankment for about 26 minutes reaching an elevation of 820.7' msl.

3.5 Conclusions and Recommendations

3.5.1 Conclusions - The erosion due to wave action appears slight and is not an immediate threat to the embankment integrity. Although there was no evidence of instability on the upstream face, the upstream side slope is steep and it is doubtful that the slope has standard safety margins.

The stability of the upper downstream slope is questionable due to the steep slopes and extensive seepage. Although no cracks were found, the slightly depressed area on the crest causes concern for embankment stability.

The extensive leakage along the left portion of the embankment appears to be the emergence of the phreatic surface at roughly elevation 806.5' msl. The seepage is uncontrolled and appears excessive. Areas of flow could lead to a piping condition.

Hydraulic analysis indicates that the project spillway is marginally adequate to pass the design storm. Outflow from the ½ PMF will overtop the right spillway bank for ½ hour possibly reaching a foot over the top of the bank that would result in failure of the bank and damage to the embankment.

The dam is in seismic zone 1 indicating that the risk of damage due to seismic activity is slight.

The dam is considered "unsafe non-emergency" because it has obviously serious deficiencies which could develop into failure modes, but do not yet pose the threat of imminent failure.

3.5.2 Recommendations - A qualified engineer should be engaged immediately to:

a. Recommend project modifications that will allow the spillway to safely discharge the design flood.

b. Investigate the seepage area and make recommendations for corrective measures.

c. Develop a plan and supervise the removal of all trees from the embankment.

d. Investigate and make recommendations concerning embankment stability.

e. Evaluate and make recommendations concerning the condition, location, and relative safety of the drawdown system with the removal of the downstream valve and the placement of a valve on the upstream end of the pipe.

f. Develop an appropriate warning system to alert downstream residents of dangerous conditions.

The owner should:

a. Remove all trees from the spillway channel.

b. Check seepage and flows at least twice a week for any change in quantity or color until engineers are engaged.

c. The operability of the drawdown drain should be checked twice a year.

d. Establish a regular program of inspection and maintenance.

SECTION 4 REVIEW BOARD FINDINGS

The Interagency Review Board for the National Program of Inspection of Non-Federal Dams met in Nashville on 27 August 1981 to examine the technical data contained in the Phase I investigation report for Akers Dam. The Review Board considered the information and recommended that (1) the hazard classification should be changed from "significant" to "high", (2) the valve on the drawdown drain should be moved to the upstream side of the embankment, (3) a check should be made to determine if head loss in the emergency spillway channel would increase the reservoir level, and (4) a volume check should be made of the inflow hydrograph of the ½ PMF, AMC II routing to verify the computations. They agreed with other report conclusions and recommendations. A copy of the letter report presented by the Review Board is included in Appendix F.

APPENDIX A
DATA SUMMARY

APPENDIX A
DATA SUMMARY

A.1 Dam

A.1.1 Type - Earthfill

A.1.2 Dimensions and Elevations

a. Crest length - 280'
b. Crest width - 11'
c. Height - 26'
d. Crest elevation (low point) - 818.4' msl
e. Upstream slope above water line - 1.4H:1V
f. Downstream slope - 2H:1V (avg.)
g. Size classification - Small

A.1.3 Zones, Cutoffs, Grout Curtains - Unknown

A.1.4 Instrumentation - None

A.2 Reservoir and Drainage Area

A.2.1 Reservoir

a. Normal Pool

1) Elevation - 814.9' msl
2) Surface area - 5 acres
3) Capacity - 48.0 acre-feet
4) Length - 950 feet

b. Maximum Pool (top of dam)

1) Elevation 819.7' msl
2) Surface area - 5.5 acres
3) Capacity - 60.7 acre-feet

A.2.2 Drainage Area

a. Size - 116.6 acres
b. Average slope - 23%
c. Soils - Bodine, Dickson
d. Land use - Forest, meadow
e. Runoff (AMC II)

1) PMF - 22.12"
2) P_{100} - 1.23"

A.3 Outlet Structures

A.3.1 Service/Emergency Spillway

a. Type - Earth and rock saddle
b. Crest elevation - 814.9'
c. Outlet channel

1) Size - 23' wide
2) Side slopes - 2.8H:1V and 6.1H:1V

d. Maximum discharge capacity - 1235 cfs

A.3.2 Drawdown Facilities

a. Type - 6" cast iron pipe through base of dam
b. Control - gate valve on downstream end

A.4 Historical Data

A.4.1 Construction Date - 1960 (est.)

A.4.2 Designer/Owner - William B. Akers

A.4.3 Builder - John Parker

A.4.4 Previous Inspections - February 4, 1980, Tennessee Division of Water Resources

A.4.5 Incidents/Failures - Overtopped near maximum section shortly after completion. Damage repaired and spillway enlarged.

A.4.6 Seismic Zone - 1

A.5 Downstream Hazard Data

A.5.1 Downstream Hazard Potential Classification

a. Corps of Engineers - High
b. State of Tennessee - 1

A.5.2 Persons in Probable Flood Path - 9

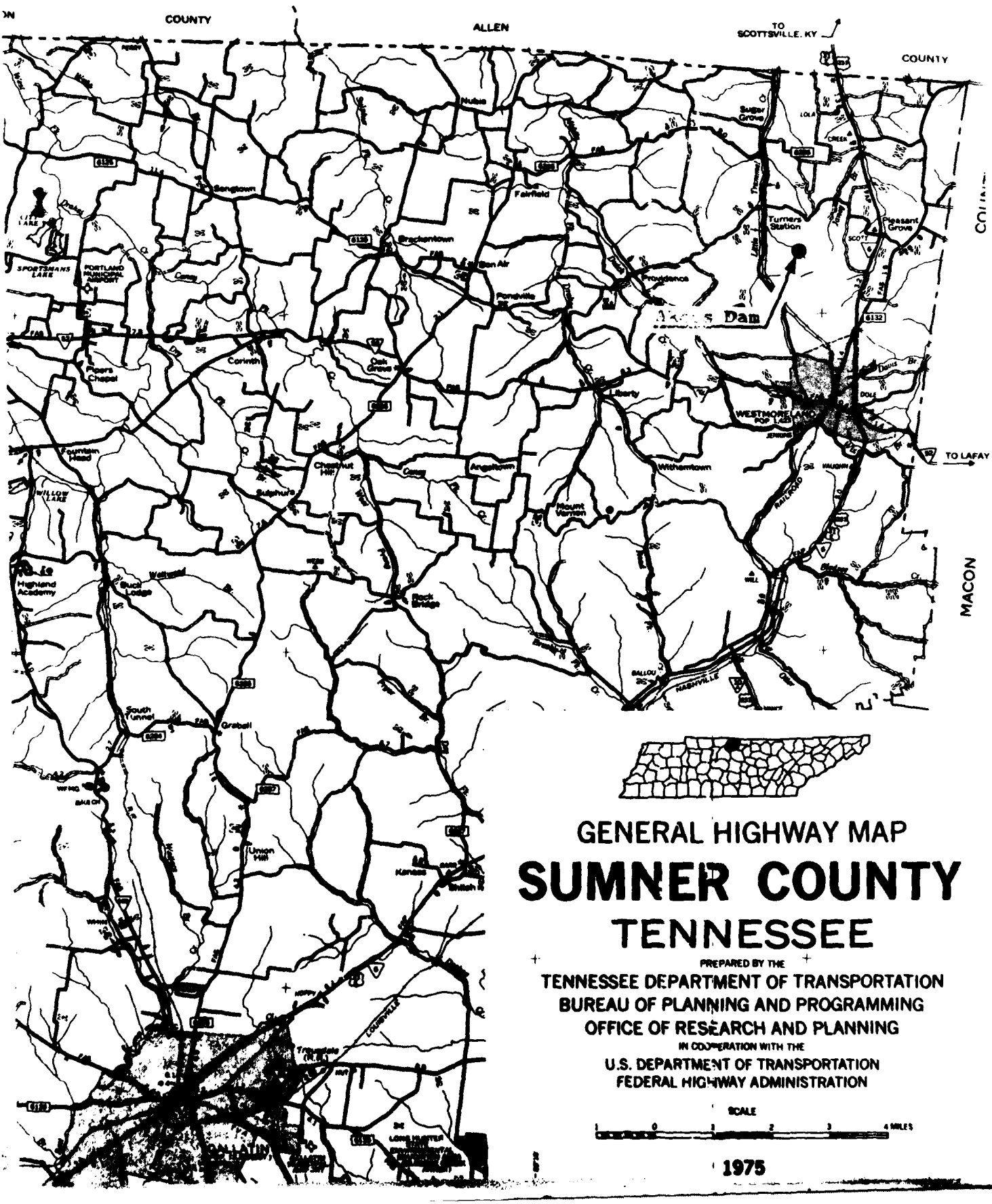
A.5.3 Downstream Property - 3 family dwellings and county road approximately 0.7 miles downstream

A.5.4 Warning Systems - None

APPENDIX B
SKETCHES AND LOCATION MAPS

K E N T U C K Y

Figure 1



GENERAL HIGHWAY MAP

SUMNER COUNTY

TENNESSEE

PREPARED BY THE

TENNESSEE DEPARTMENT OF TRANSPORTATION
BUREAU OF PLANNING AND PROGRAMMING
OFFICE OF RESEARCH AND PLANNING

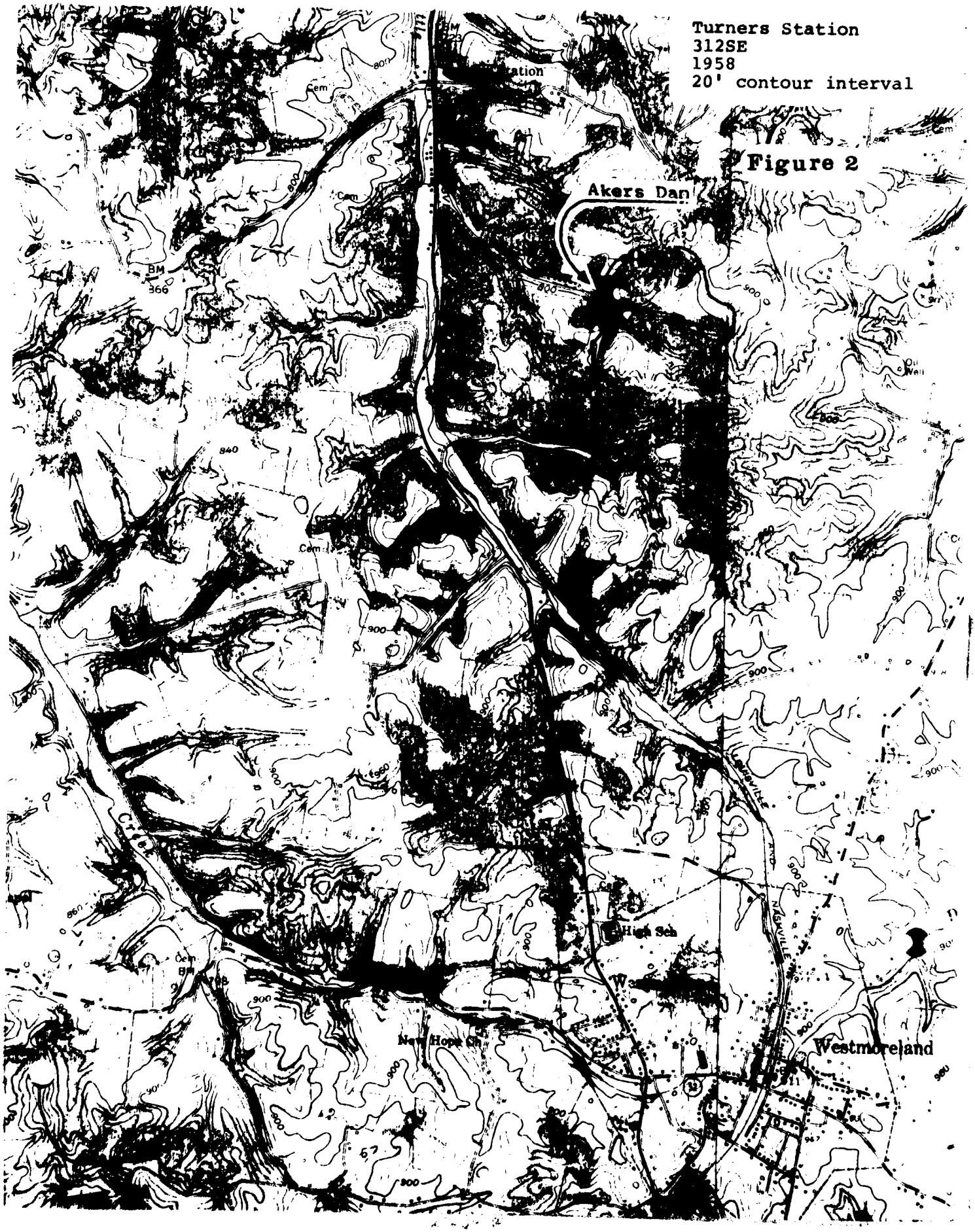
IN COOPERATION WITH THE

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

SCALE

1 0 1 2 3 4 MILES

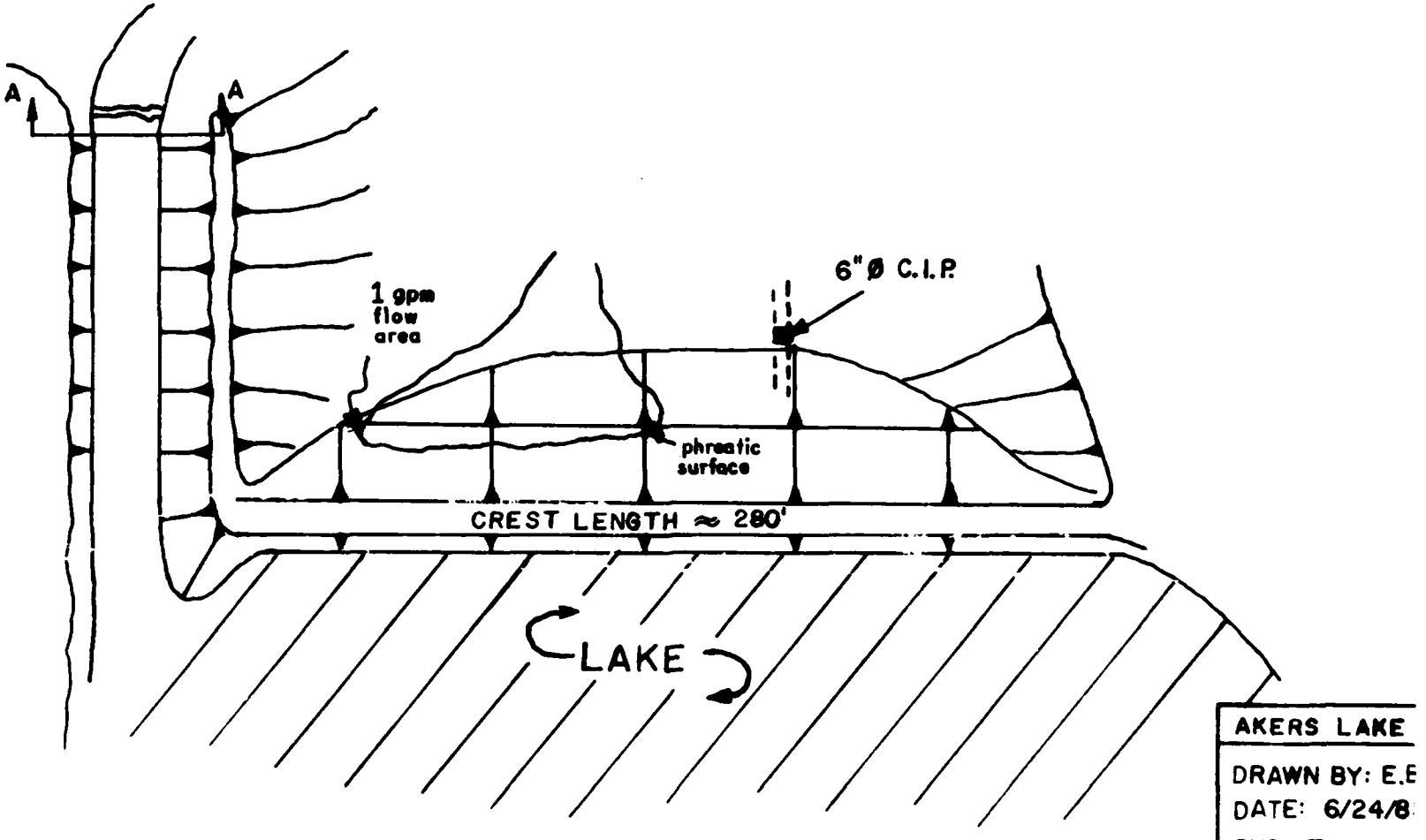
1975


Turners Station
312SE
1958
20' contour interval
Figure 2
Akers Dan
Cem
BM
366
840
900
Creek
High Sch
New Hope Ch
Westmoreland
NASHVILLE

GENERAL PLAN

SCALE 1"=50'

FIGURE 3



AKERS LAKE

DRAWN BY: E.E

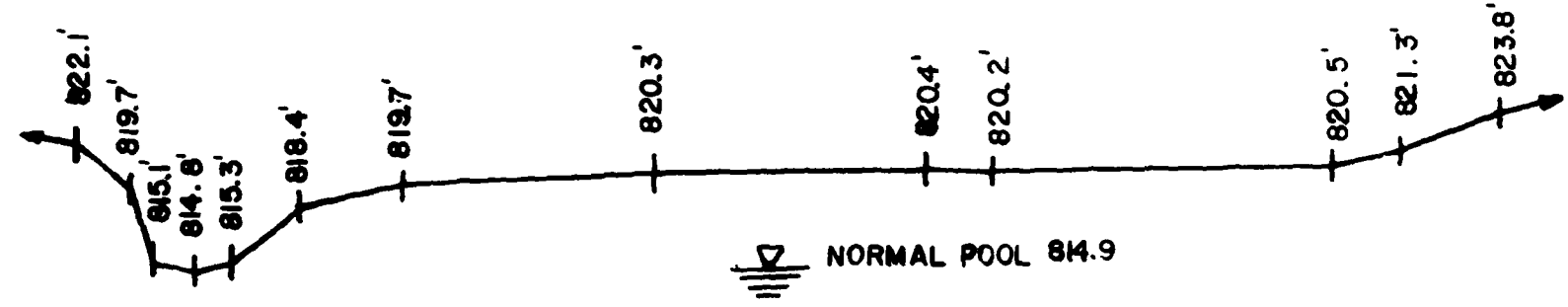
DATE: 6/24/8

SHEET 1 OF

EMBANKMENT PROFILE

HOR. SCALE 1"=50' VERT. SCALE 1"=10'

FIGURE 4



DAM

AKERS LAKE

DRAWN BY: E.B.

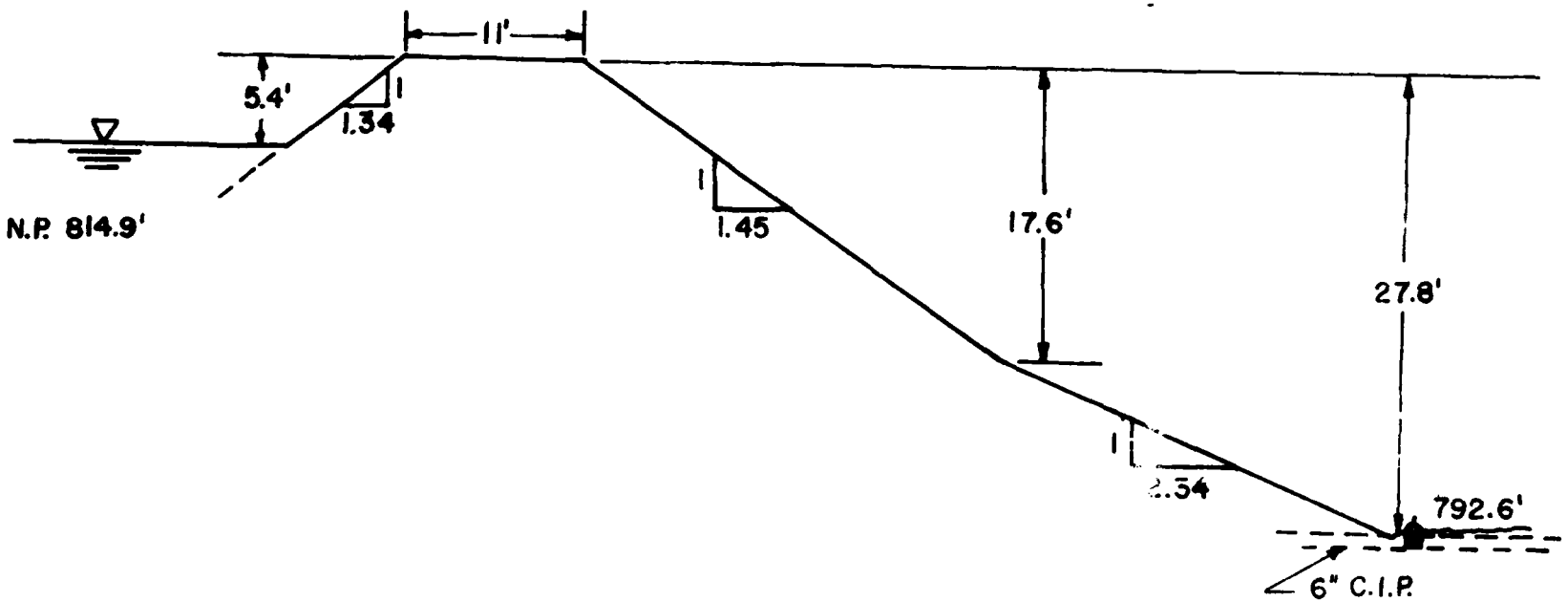
DATE: 6/22/81

SHEET 2 OF 5

MAXIMUM SECTION AT STATION 1+78

HOR. SCALE 1"=10' VERT. SCALE 1"=10'

FIGURE 5



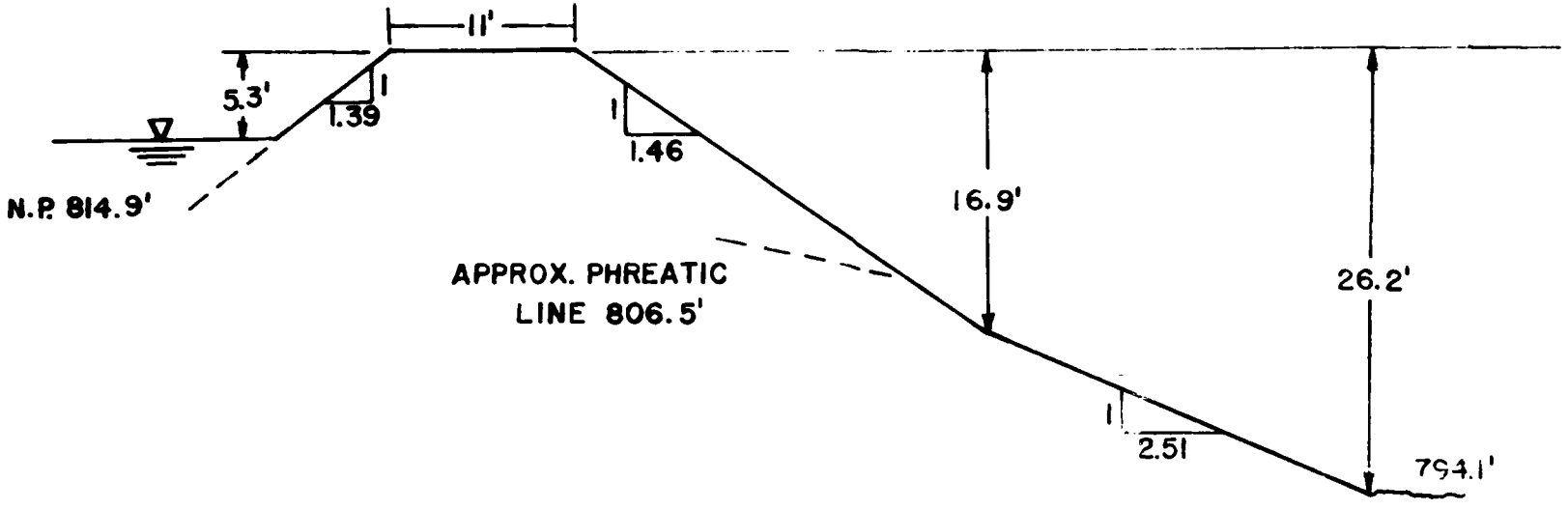
AKERS LAKE

DRAWN BY: E.B.P.
DATE: 6/23/81
SHEET 3 OF 5

TYPICAL SECTION AT 1+00

HOR. SCALE 1"= 10' VERT. SCALE 1"=10'

FIGURE 6



AKERS LAKE

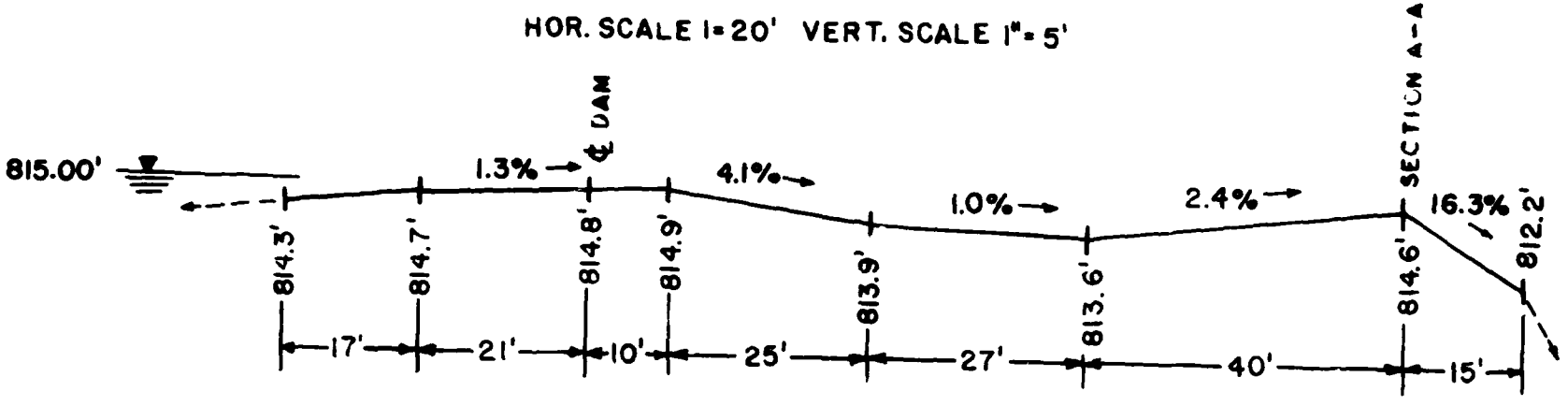
DRAWN BY: E.B.

DATE: 6/24/81

SHEET 4 OF 5

SPILLWAY PROFILE

HOR. SCALE 1=20' VERT. SCALE 1"= 5'



SPILLWAY CROSS-SECTION A-A

HOR. SCALE 1"=10' VERT. SCALE 1"= 5'

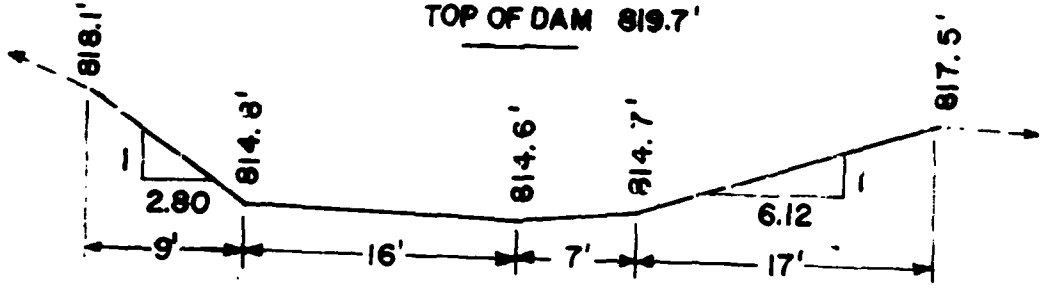


FIGURE 7

AKERS LAKE
DRAWN BY: E.B.P.
DATE: 7/1/81
SHEET 5 OF 5

APPENDIX C
PHOTOGRAPHIC LOG

Akers Dam
Photographic Log

Photo No. 1 - View of crest from right abutment.

Photo No. 2 - View of upstream face and spillway entrance from left reservoir bank.

Photo No. 3 - Downstream face from right abutment.

Photo No. 4 - Downstream face.

Photo No. 5 - Spillway entrance channel.

Photo No. 6 - Spillway control section and discharge channel.

Photo No. 7 - Downstream toe in area of drawdown drain valve.

Photo No. 8 - Drawdown drain valve.

Photo No. 9 - Extensive seepage area near left abutment. Note range pole and machete indicate extent of seepage.

Photo No. 10 - Sloughing in the area of extensive seepage.

Photo No. 11 - Extensive seepage area from left abutment. Note plush vegetative growth.

Photo No. 12 - Extensive seepage area from left toe area.

Photo No. 13 - Flow area near left abutment.

Photo No. 14 - Close up of flow area. Note gradation of coarse embankment material.

Photo No. 15 - Small flow area near drawdown valve.

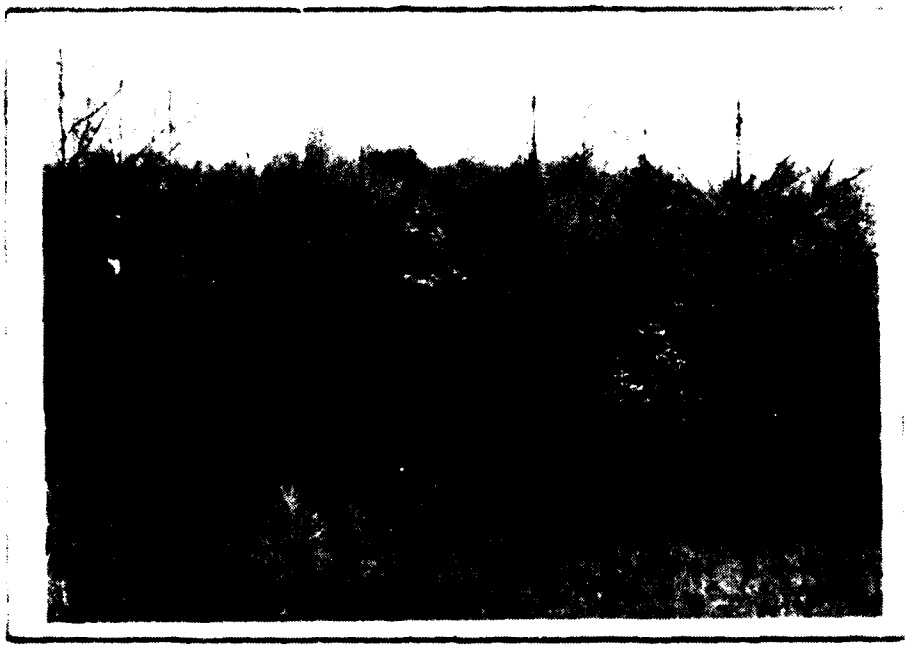
Photo No. 16 - Close up of small flow

Photo No. 17 - Cumulative flow from seepage area.

Photo No. 18 - Stream channel from culvert at Old Hwy 31.

PHOTO NO.1

PHOTO NO.2



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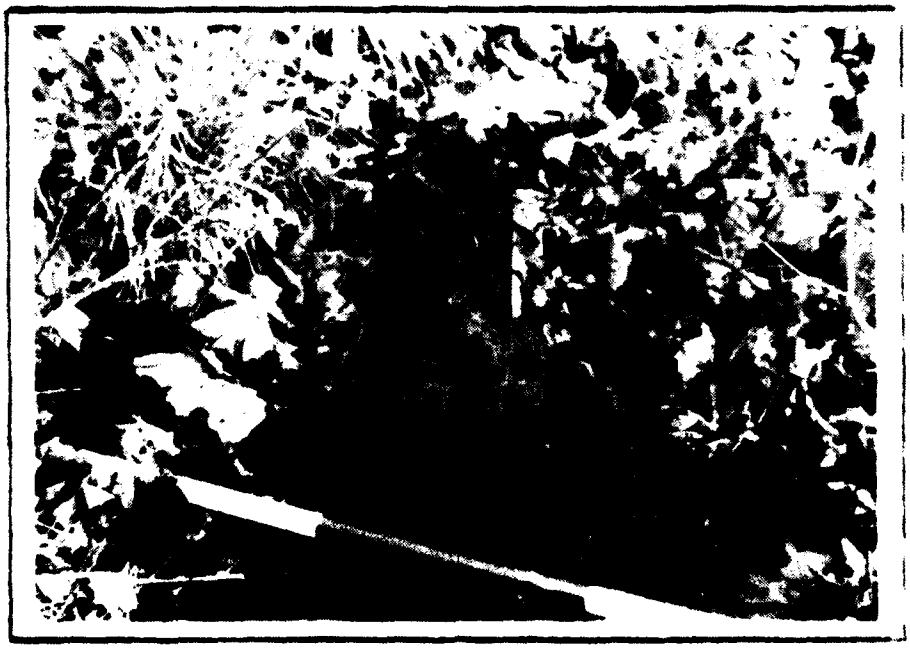

PHOTO NO.8

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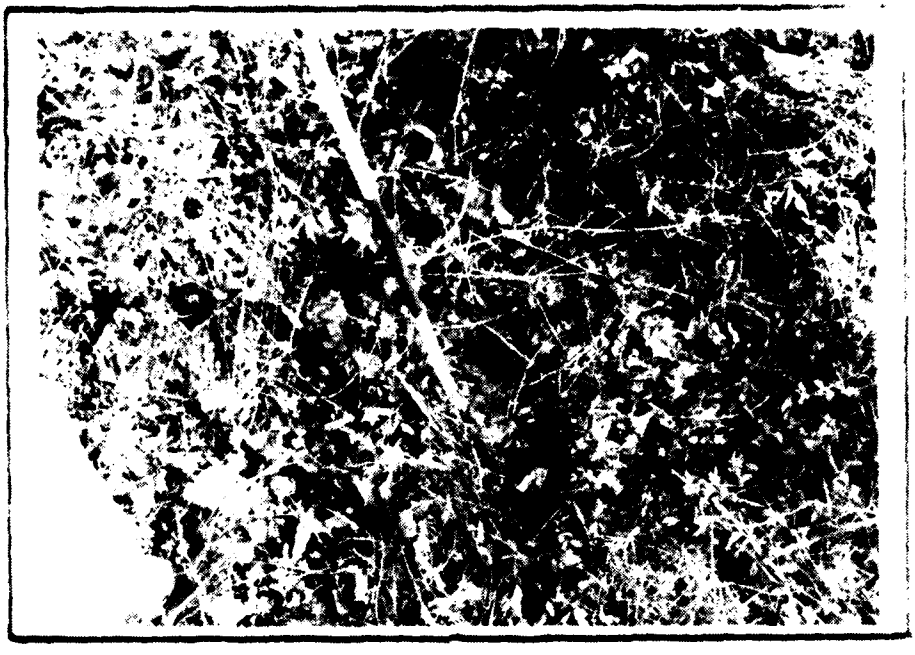

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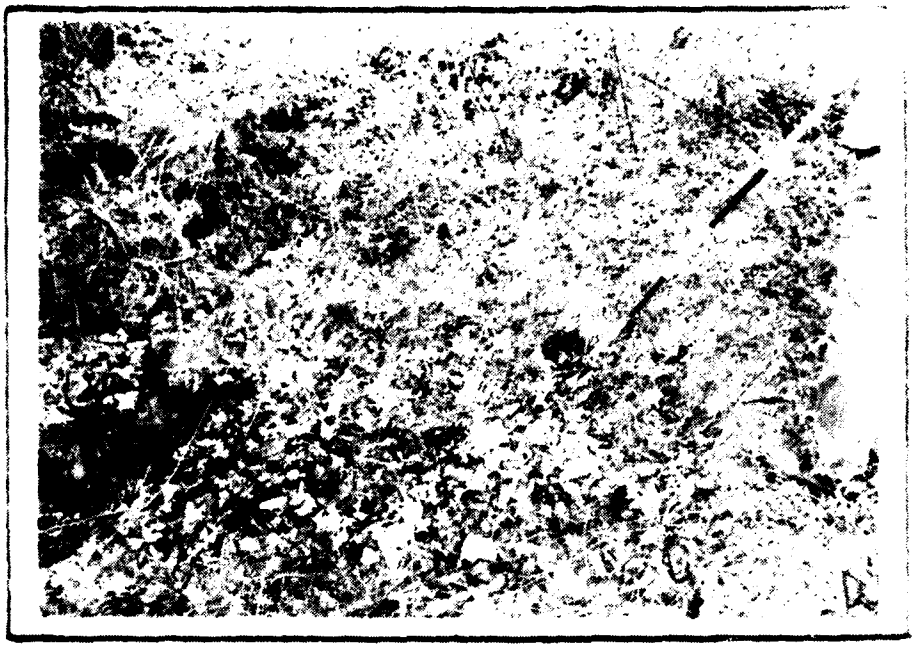

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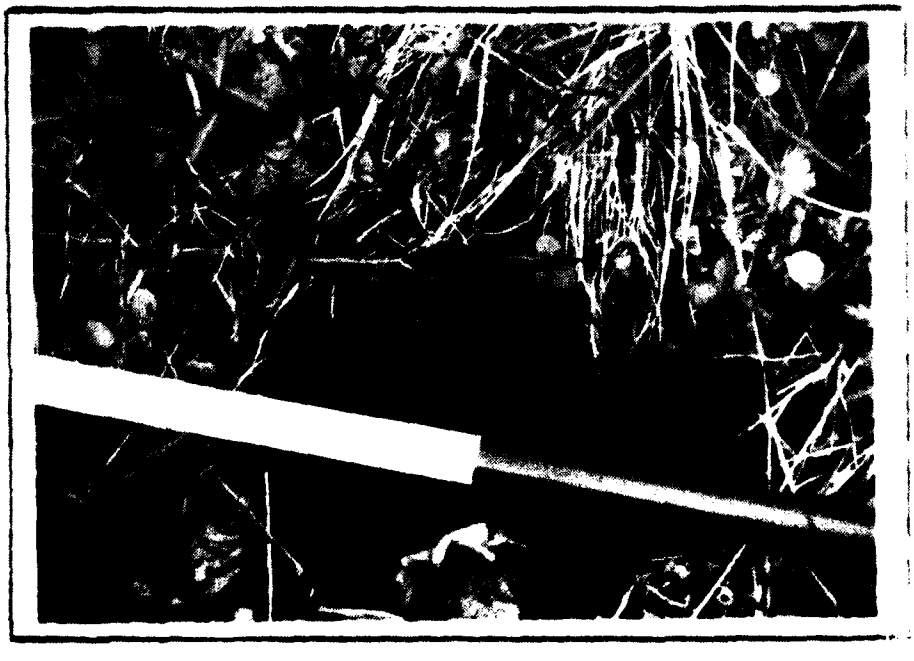

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PHOTO NO.18

APPENDIX D
CHECK LIST

Check List
Visual Inspection of Earth Dams
Department of Conservation
Division of Water Resources

Name of Dam Akers Dam

County Sumner Date of Inspection 4/15/81

ID # - State 83-7010 Federal TN-16510

Type of Dam Earth

Hazard Category-Federal _____ State _____

Weather Sunny with light haze Temperature 65°F

Pool at Time of Inspection About 3.5' (distance from crest)

Tailwater at Time of Inspection 0 (distance from stream bed)

Design/As Built Drawings Available: Yes _____ No X

Location: _____

Copy Obtained: Yes _____ No _____

Reviewed: Yes _____ No _____

Construction History Available: Yes _____ No X

Location: _____

Copy Obtained: Yes _____ No _____

Reviewed: Yes _____ No _____

Other Records and Reports Available: Yes _____ No X

Location: _____

Copy Obtained: Yes _____ No _____

Reviewed: Yes _____ No _____

Prior Incidents or Failures: Yes X No _____

Inspection Personnel and Affiliation:

Troy Wedekind - TDWR _____

Bob Ramsey - TDWR _____

_____ _____

_____ _____

I. Embankment

A. Crest

Description (1st inspection) Some variation of crest width and a general elevation decline across the crest toward the left end of dam. The area of the left end of dam is roughly 2 feet below the average crest elevation.

1. Longitudinal Alignment Linear

2. Longitudinal Surface Cracks A faint outline of a curved line extending roughly 30' from one point on the downstream edge of the crest to another and located near the maximum section. The line was not associated (See I.A.5 below)

3. Transverse Surface Cracks None found

4. General Condition of Surface Good grass cover along entire crest. Transverse alignment varies from a slight U/S dip changing to a slight D/S and changing back along much of the crest.

5. Miscellaneous With any obvious crack and only a slight appearance of displacement. Crest is constricted near the middle that may be attributed to reported overtop.

B. Upstream Slope

1. Undesirable Growth or Debris Moderately heavy brush and small diameter trees, mainly deciduous, covering entire face. Some trees up to 6" diameters.

2. Sloughing, Subsidence, or Depressions None found

3. Slope Protection Vegetative cover only with no design protection although some rock was observed along the water line.

a. Condition of Riprap None found

b. Durability of Individual Stones N/A

c. Adequacy of Slope Protection Against Waves and Runoff Adequate, slight erosion at normal pool with small benching.

d. Gradation of Slope Protection - Localized Areas of Fine Material N/A

4. Surface Cracks None found

C. Downstream Slope

1. Undesirable Growth or Debris Some briers, brush, and small diameter trees but mainly trees between 2" and 8" diameters covering entire slope.

2. Sloughing, Subsidence, or Depressions; Abnormal Bulges or Non-Uniformity Sloughing area along much of the left half of the dam on the lower half of the embankment and appears to be associated with the emergence of the phreatic line.

3. Surface Cracks on Face of Slope None found

4. Surface Cracks or Evidence of Heaving at Embankment Toe None found

5. Wet or Saturated Areas or Other Evidence of Seepage on Face of Slope; Evidence of "Piping" or "Boils"

Intermittent wet areas with swamp grass on the lower half of the dam from maximum section to roughly middle of dam. A large wet area roughly 10' below the crest and located on the left third of the dam had a few flow areas (See section I.D.4).

6. Drainage System None found

7. Fill Contact with Outlet Structure N/A

8. Condition of Grass Slope Protection Generally poor grass cover due to tree and brush growth. No erosion was noted.

D. Abutments

1. Erosion of Contact of Embankment with Abutment from Surface Water Runoff, Upstream or Downstream _____

Erosion along the right downstream contact that is less than 1' deep and extends from the toe to 1/3 of height.

2. Springs or Indications of Seepage Along Contact of Embankment with the Abutments Small seep near right toe in the area of drain valve.

3. Springs or Indications of Seepage in Areas a Short Distance Downstream of Embankment - Abutment Tie-in

None found.

4. that appeared clear and flowed at 1 gpm. All wet areas on the downstream face generally appeared to start at the same approximate elevation and therefore appeared to be the emergence of the phreatic line.

II. Area Downstream of Embankment, Including Channel

A. Localized Subsidence, Depressions, Sinkholes, Etc. None found

B. Evidence of "Piping", "Boils", or "Seepage" None found

C. Unusual Presence of Lush Growth, such as Swamp Grass, etc. Lush growth around cumulative outflow from embankment seepage.

D. Unusual Muddy Water in Downstream Channel None found

E. Sloughing or Erosion None found

F. Surface Cracks or Evidence of Heaving Beyond Embankment Toe None found

G. Stability of Channel Sideslopes Channel within 100' D/S of dam is flat and shallow so consequently has virtually no side slopes.

H. Condition of Channel Slope Protection N/A

I. Adequacy of Slope Protection Against Waves, Currents, and Surface Runoff N/A

J. Miscellaneous

K. Condition of Relief Wells, Drains, and Other Appurtenances None found

L. Unusual Increase or Decrease in Discharge from Relief Wells N/A

III. Instrumentation

A. Monumentation/Surveys None found

B. Observation Wells None found

C. Weirs None found

D. Piezometers None found

E. Other

IV. Spillways

A. Service Spillway (Service/Emergency Combination Yes X No __)

1. Intake Structure Condition _____

2. Outlet Structure Condition _____

3. Pipe Condition _____

4. Evidence of Leakage or Piping _____

5. General Remarks _____

B. Emergency Spillway

1. General Condition Good, channel is excavated in rock at left abutment. Right channel side is low at the junction with embankment and may cause flow down embankment during high flows.

2. Entrance Channel Good, slopes up from reservoir then flattens into channel.

3. Control Section Channel is generally flat for at least 50' so flow will be well developed although side slopes are somewhat irregular. Critical depth should easily occur near end of the control section.

3. Exit Channel Control section discharges down an undefined channel into a natural drainage for the backside of left abutment.

4. Vegetative/Woody Cover Many trees, up to 3" in diameter in control section and side slopes.

5. Other Observations Spillway was reportedly enlarged shortly after construction.

V. Emergency Drawdown Facilities (if part of service spillway so state) Cast iron pipe that is valved at the downstream end. Outlet is buried but pipe is believed to be 6" in diameter.

Are Facilities Operable: Yes _____ No _____ Unknown

Were Facilities Operated During Inspection: Yes _____ No X

Date Facilities Were Last Used Probably 1960.

VI. Reservoir

A. Slopes Moderately steep as observed from surrounding topography.

B. Sedimentation Little expected. No signs of siltation in upper reaches.

C. Turbidity Slight. Visibility at least 3'.

VII. Drainage Area

Description (for hydrologic analysis) 20% meadow, 80% woods

A. Changes in Land Use Little expected.

VIII. Downstream Area (Stream)

A. Condition (obstructions, debris, etc.) Stream is shallow and passes through woods for 100' immediately D/S of dam and a 200' wooded section about 1/2 mile D/S. Stream passes under a road into a deep channel, roughly 4' deep, 0.7 miles D/S.

B. Slopes Moderate, roughly 2% until it meets the Little Trammel Creek.

C. Approximate No. Homes, Population, and Distance D/S

Three homes located 0.7 miles D/S near stream channel. Estimated population is 9. A few other structures further D/S along Little Trammel Creek could also be damaged.

D. Other Hazards Section of Old Hwy 31

IX. Miscellaneous

Incidents/Failures A portion of the dam near the maximum section was damaged from overtopping shortly after the dam was completed. The dam has since been repaired and the spillway enlarged.

Observed Geology of Area Rock in spillway channel appeared to be a dolomitic siltstone of the Fort Payne Formation.

X. Conclusions

1. Flows from embankment in early stages of piping.

2. Seepage from embankment appears to be the emergence of the phreatic line. See page 14 for continuation.

XI. Recommendations

1. A qualified engineer should be engaged to: a) recommend project modifications that will allow the spillway to safely discharge the design storm; b) investigate and make recommendations concerning the stability of the dam that includes the removal of all trees; c) Evaluate and make recommendations concerning the condition and relative safety of the drawdown system that includes the moving of the valve upstream; and d) investigate the seepage area and make recommendations for corrective measures.

Regional Engineer

Chief Engineer

X. Conclusions (cont.)

3. Stability questionable due to steep slopes and seepage.

4. Discharge channel will be overtopped by design storm and will result in damage to embankment.

5. Dam is considered "unsafe-nonemergency".

APPENDIX E
HYDRAULICS AND HYDROLOGY

Hydraulics and Hydrology

Being in the small size and significant hazard potential categories, Akers Dam is required to pass the ½ PMF according to OCE guidelines. Based on the U. S. Weather Service's TP-40, the 6 hour PMP was estimated to be 28.35". A dimensionless unit hydrograph technique described in Chapter 21, Section 4 of the SCS National Engineering Handbook was used to compute a runoff hydrograph for the PMP using both antecedent moisture condition II and III to determine runoff. The ½ PMF was formed by taking half the flow values of the PMF. Flood hydrographswas routed through the reservoir by the equation:

$$I_1 + I_2 + \left(\frac{2S_1}{\Delta t} - O_1\right) = \frac{2S_2}{\Delta t} + O_2$$

The peak inflow for the ½ PMF AMC III is 1,286 cfs resulting in a peak outflow of 1,005 cfs.

Aker's Dam

SUMMARY OF ROUTINGS

EVENT	ANTECEDENT MOISTURE CONDITION	
	II	III
6 hr. PMF	Overtopped a maximum of .6 ft for 26 min.	Overtopped a maximum of 1 ft for 50 min.
6 hr. ½ PMF	Passed	Passed Elev. 819.3' msl
6 hr. P_{100}	Passed	Passed

Aker's Dam Sumner Co. TAW 1/5

Basin Characteristics:

drainage area	116.6 acres (0.183 sq. mi.)
average watershed slope, Y	23%
longest flow length, ℓ	1775 feet

SCS Curve Number

soil	% DA	H.S.G.	% soil usage	
Bodine	85	B	25% meadow	75% woods
Dickson	15	C	100% woods	

$$\text{AMC II } CN = 0.15(73) + 0.85[0.25(58) + 0.75(60)]$$
$$= 10.95 + 50.58$$
$$= 61.53 \text{ say } \underline{62}$$

$$\text{AMC III } CN = \underline{79}$$

Time of Concentration

$$T_c = L/0.6$$
$$L = (S+1)^{0.7}\, \ell^{0.8}/1900\, Y^{0.5}$$
$$S = \frac{1000}{CN} - 10$$

	AMC II	AMC III
$\therefore T_c =$	0.29 hrs	0.18

Hydrograph formation from NEH-4 Chap. 21

Aker's Dam Sumner Co. TAW 2/5

Routing Curve (ref. Figure 1)

Elev.	Storage (DSF)	Outflow (cfs)	$\frac{2S}{\Delta t} + O$ (9 min cfs)
815	0.00	0.0	0
815.5	1.32	26.7	450
816	2.65	80.3	927
816.5	3.97	156.3	1427
817.0	5.29	254.3	1948
817.5	6.62	374.6	2492
818	7.94	517.8	3058
818.5	9.26	684.7	3647
819	10.59	876.0	4263
819.5	11.91	1092.6	4904
819.8	12.7	1235.0	5300
820	13.23	1339.5	5579
820.3	14.03	1546.9	6035
820.5	14.56	1934.8	6592
820.8	15.35	2331.1	7293
821.	15.88	2653.1	7734

Outflow (spillway) from EQ. 8-60 Brater and King Handbook of Hydraulics

Outflow (overtop) from EQ 8-53 " " " "

All head losses are neglected because of the short channel length and the gradual reduction in side slopes.

sample calculations for ½ PMF AMC III event

D.A. = 116.6 ac

AMC III CN = 79

PMP = 28.35" 6 hr duration

Q_{PMP} = 25.39"

Hydrograph Family Number 1

T_c = 0.18 hrs

$Rec T_o/T_p$ = 50

$T_{p\,REV}$ = 0.11 hrs

Qq_p = 19337 cfs

PMF peak flow = 2572 cfs @ 2.06 hrs

½ PMF is half of the flow coordinant of the PMF (ref Figure 4)

portion of ½ PMF Hydrograph

n	t(hrs)	Q(cfs)	
0	0.00	0.0	
1	0.23	18.3	
2	0.46	50.3	
3	0.69	82.2	
4	0.92	114.1	
5	1.14	145.9	
6	1.37	185.6	
7	1.60	250.4	
8	1.83	558.8	
9	2.06	1285.9	peak
10	2.29	909.8	
11	2.52	489.7	

Hydrograph volume check

runoff volume = $\frac{25.39}{2}$ × 116.6 ac

= 123.35 ac ft

hydrograph volume = $\frac{\Sigma Q \times \Delta t}{43560\ sq\ ft^3}$

= 125.29 ac ft

error = 1.6%

∴ hydrograph volume ≈ runoff volume

½ PMF AMC III Routing

r	t (hrs)	I (cfs)	2S/Δt − O (cfs)	2S/Δt + O (cfs)	O (cfs)
0	0.00	0	0	0	0
1	0.15	12	11	12	0.5
2	0.3	27	47	50	1.5
3	0.45	50	114	124	5.0
4	0.6	66	206	230	12
5	0.75	88	320	360	20
6	0.9	108	442	516	37
7	1.05	128	592	678	49
8	1.2	150	720	860	70
9	1.35	180	860	1050	95
10	1.5	218	1008	1258	125
11	1.65	268	1174	1494	160
12	1.8	398	1384	1840	228
13	1.95	920	1852	2702	425
14	2.1	1286	2438	4058	810
15	2.25	933	2647	4657	1005 (819.3' m.s.l.)
16	2.4	695	2525	4275	875
17	2.55	465	2295	3685	695
⋮	⋮	⋮	⋮	⋮	⋮

Conclusion: spillway passes storm reaching a water surface elevation of 819.3' m.s.l.

Addendum - Hydraulic & Hydrologic Data

PMF AMC III Hydrograph Volume Check

n	t(hrs)	Q(cfs)
1	0.00	0.0
2	0.23	36.7
3	0.46	100.6
4	0.69	164.4
5	0.92	228.2
6	1.15	292.0
7	1.37	371.3
8	1.60	500.8
9	1.83	1117.7
10	2.06	2571.8
11	2.29	1819.6
12	2.52	978.4
13	2.75	690.3
14	2.98	574.3
15	3.21	491.2
16	3.44	423.5
17	3.66	371.3
18	3.89	332.6
19	4.12	307.5
20	4.35	290.1
21	4.58	280.4
22	4.81	270.7
23	5.04	263.0
24	5.27	253.3
25	5.50	241.7
26	5.73	237.8
27	5.95	30.9
28	6.18	0.0
		13,239.9 cfs

$V = \Delta t \Sigma Q$

where $\Delta t = 0.229$ hrs

$V = 0.229 \text{ hrs} \cdot 3600 \text{ sec/hr} \cdot (13,239.9 \text{ cfs}) / 43560 \text{ sq ft/ac}$

$= 250.6$ ac ft

Runoff Volume $= 25.39'' / 12'' \cdot (116.6 \text{ ac})$

$= 246.7$ ac ft

error $= [(250.6 - 246.7)/246.7] \times 100\% = 1.6\%$

Conclusion: hydrograph volume approximates runoff volume from TR-

Addendum - Hydraulic & Hydrologic Data

½ PMF AMC III Hydrograph Volume Check

n	t (hrs)	Q (cfs)
1	0.00	0.0
2	0.23	18.4
3	0.46	50.3
4	0.69	82.2
5	0.92	114.1
6	1.15	146.0
7	1.37	185.6
8	1.60	250.9
9	1.83	558.8
10	2.06	1285.9
11	2.29	909.8
12	2.52	489.2
13	2.76	345.2
14	2.98	287.2
15	3.21	245.6
16	3.44	211.7
17	3.66	185.6
18	3.89	166.3
19	4.12	153.7
20	4.35	145.0
21	4.58	140.2
22	4.81	135.9
23	5.04	131.5
24	5.27	126.7
25	5.50	120.9
26	5.73	118.9
27	5.95	15.5
28	6.18	0.0

$\Sigma = 6620.1$ cfs

$V = \Delta t \Sigma Q$

$\Delta t = 0.11$ hrs

$\therefore V = \frac{0.23 (6620.1) \text{ cfs hrs} (3600 \text{ sec/hr})}{43560 \text{ ft}^2/\text{ac}}$

$= 125.3$ ac-ft

½ PMP runoff volume $= \frac{25.39''/2}{12''/\text{ft}} \times 116.6$ ac

$= 123.9$ ac-ft

$\text{error} = \frac{(125.3 - 123.9)}{123.9} \times 100\%$

$= 1.5\%$

Conclusion: hydrograph volume approximates half the runoff volume from the PMP

Addendum – Hydraulic and Hydrologic Data

Friction Loss Check for Spillway Channel

Critical Flow Parameters (see Figure 1)

$$Q = \sqrt{g \frac{(B + z D_c)^3}{B + 2z D_c}}\, D_c^{3/2}$$ eq (8-56) Kings Handbook

where Q = flow rate = 1005 cfs from ½ PMF AMC II Routing (ref. sheet 4/5)
B = base width = 23'
z = average channel slope = 4.46
D_c = critical depth

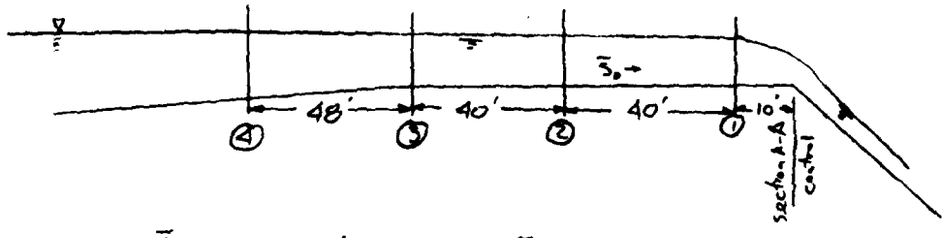
$\therefore D_c = 3.159'$

Friction Losses
ignore all losses except friction
assume control not submerged
assume all spillway flow contained within channel

$$h_f = K_f \frac{V^2}{2g}$$

$$K_f = 29.1\, n^2 L / R^{4/3}$$

where: n is Mannings roughness coefficient = 0.07
L is distance of reach for head loss computation
R is hydraulic radius



$\bar{S}_o$ = average slope = 0.326%

section channel geometry from field survey at points ③ & ④
point ② geometry is interpolated
point ① geometry is assume same as control
point ① is assumed to just upstream from rapid drawdown area

Addendum - Hydraulic & Hydrologic Data

Channel Head Loss (cont'd)

section ① same as Figure 7

$$Q = \frac{1.486\, A^{5/3} S_0^{1/2}}{n\, P^{2/3}} = \frac{1.486}{n} A R^{2/3} S_0^{1/2}$$

where

$A = B y_n + y_n^2 \left(\frac{z_1 + z_2}{2}\right)$

$P = B + y_n\left(\sqrt{z_1^2+1} + \sqrt{z_2^2+1}\right)$

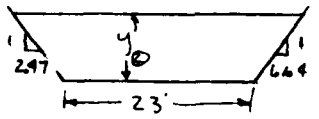
$R = A/P$

solve for y_n

$y_n = 4.11'$ elevation = 818.72

section ②

assume $y_②$ = 4.236



$A_②$ = 179.162 sqft

$P_②$ = 62.732'

$R_②$ = 2.856'

$V_②$ = 5.61 fps

$h_{f_②} = K_{f_②} \frac{V_②^2}{2g}$ where $K_{f_②} = 29.1\,(0.03)^2 (40)/(2.829)^{4/3}$

$= 0.126'$

assumed $h_{f_②} = 0.126'$

Addendum - Hydraulic & Hydrologic Data

(Channel Head Loss (cont))

Section ③

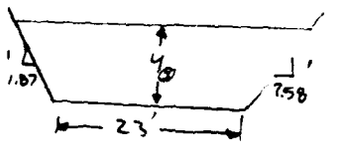
assume $y_③ = 4.347'$ elevation ③ = 819.25' msl

$A_③ = 189.267$ sq ft

$P_③ = 65.454'$

$R_③ = 2.892'$

$V_③ = 5.31$ fps



$h_{f_③} = K_{f_③} V_③^2/2g$ where $K_{f_③} = 29.1(0.03)^2(40)/(2.892)^{4/3}$

$= 0.111'$

assumed $h_{f_③} = 0.111'$

Section ④

assume $y_④ = 4.45'$ elevation ④ = 818.75

$A_④ = 216.214$ sq ft

$P_④ = 75.328'$

$R_④ = 2.87'$

$V_④ = 4.698$ fps

$h_{f_④} = K_{f_④} V_④^2/2g$ where $K_{f_④} = 29.1(0.03)^2(48)/(2.87)^{4/3}$

$= 0.104'$

assume $h_{f_④} = 0.103'$

elevation ④ < elevation ③ ∴ section ④ has backwater effect

From ③ i.e. lake level is 819.25'

Conclusion: Friction head loss ≈ 0.5' but spillway rating will not be affected due to the conservative assumption made for spillway rating (i.e. flat channel bed)

AKER'S LAKE

FLOOD ROUTING CURVE

$2S/\Delta t + O$ VS. O

FIGURE 1

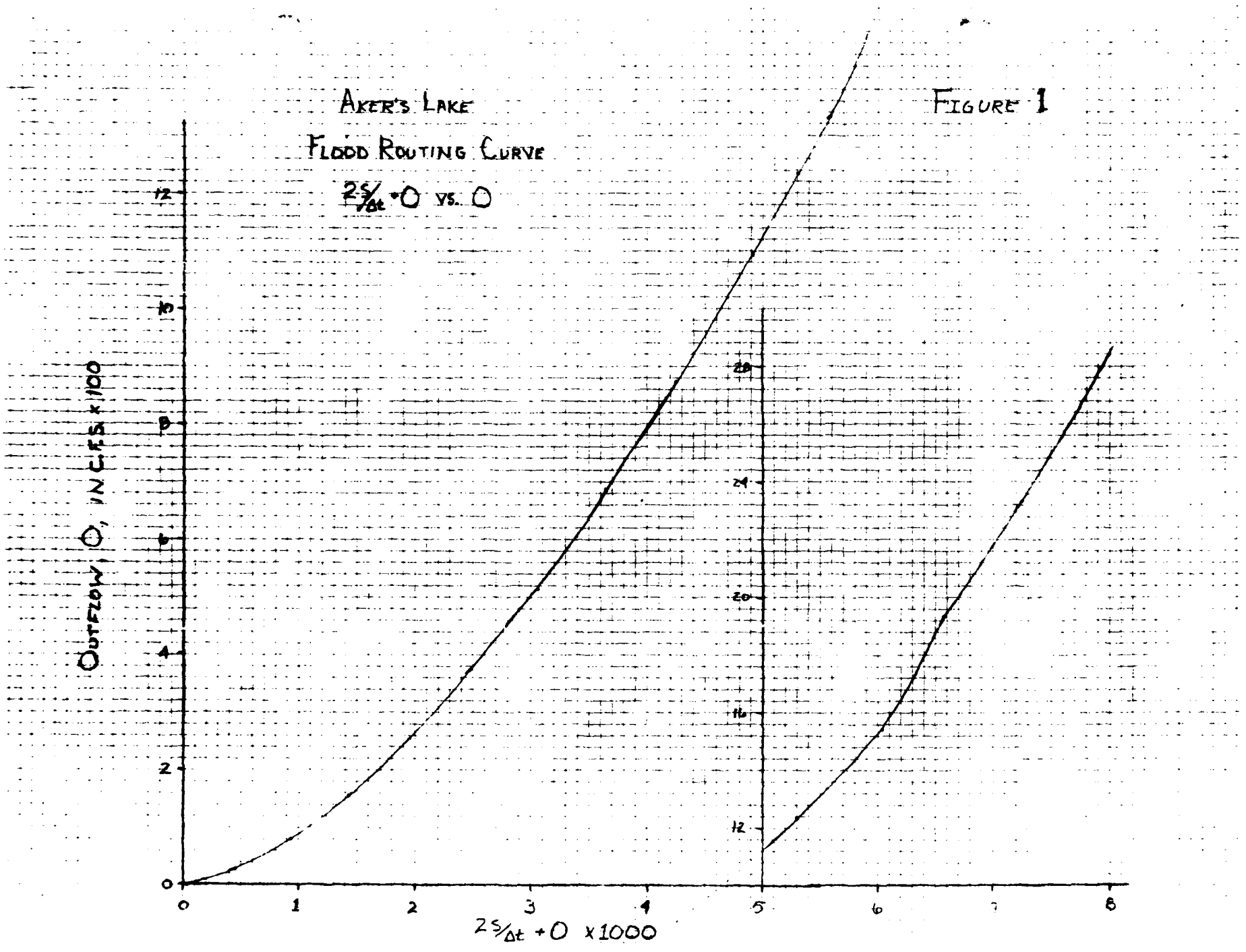


FIGURE 2

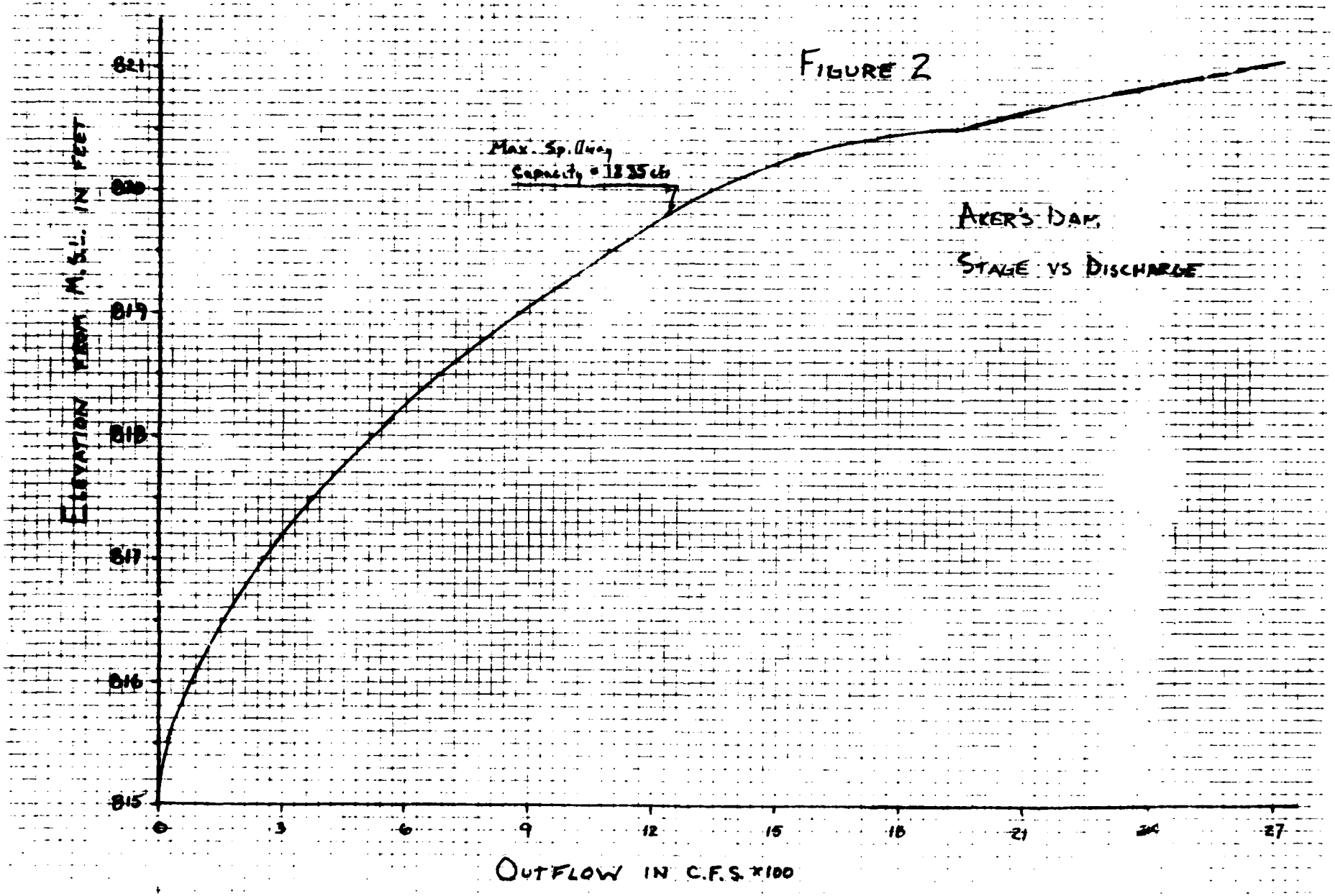
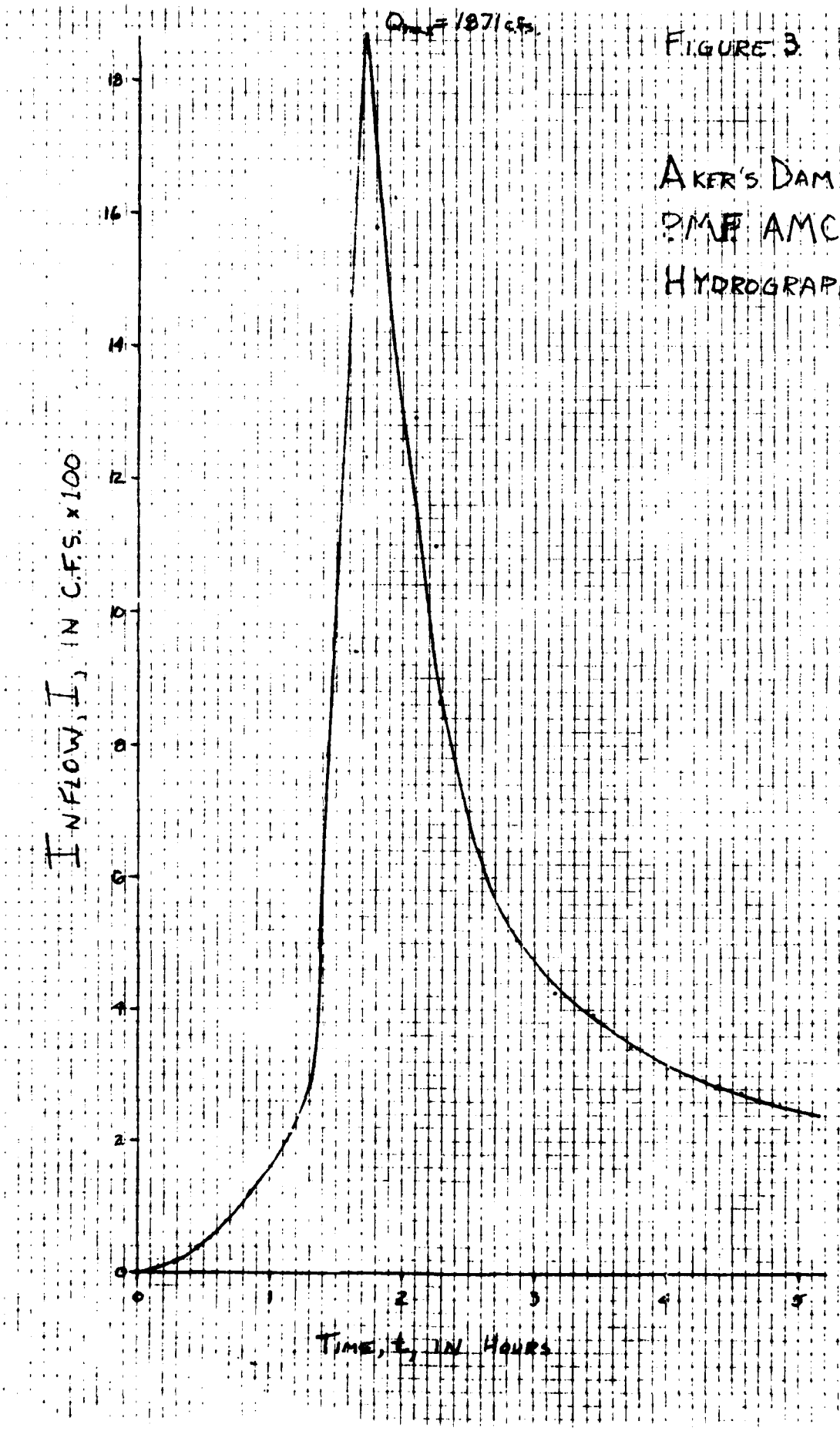

Max. Sp. Flow
Capacity = 1235 cfs
AKER'S DAM
STAGE VS DISCHARGE
ELEVATION FROM M.S.L. IN FEET
821
820
819
818
817
816
815
0
3
6
9
12
15
18
21
24
27
OUTFLOW IN C.F.S. X100

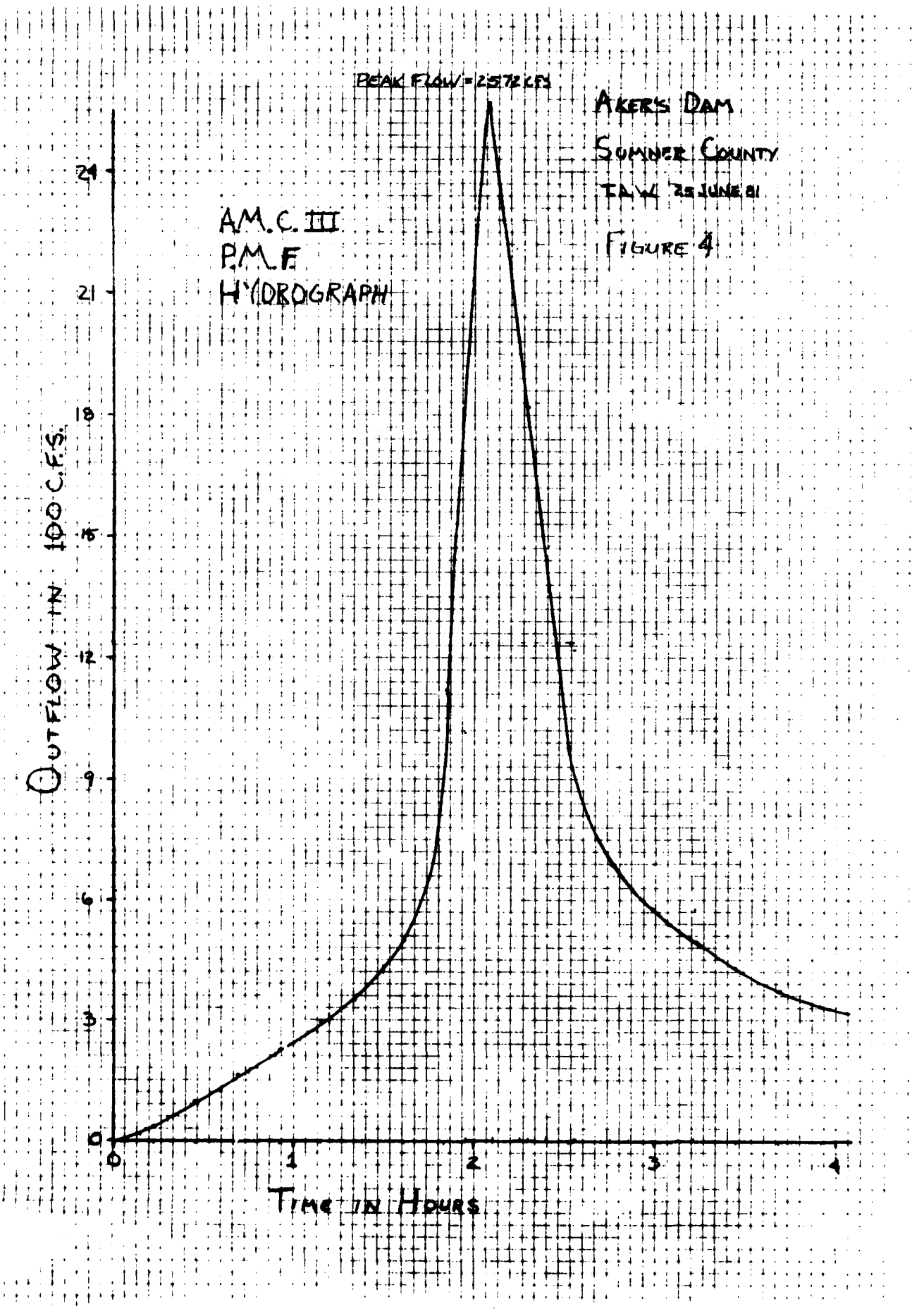
FIGURE 3.

AKER'S DAM

PMF AMC II

HYDROGRAPH




PEAK FLOW = 2572 CFS
AKERS DAM
SUMNER COUNTY
TN W 25 JUNE 81
A.M.C. III
P.M.F.
HYDROGRAPH
FIGURE 4
OUTFLOW IN 100 C.F.S.
0
3
6
9
12
15
18
21
24
0
1
2
3
4
TIME IN HOURS

APPENDIX F

CORRESPONDENCE

DEPARTMENT OF THE ARMY
NASHVILLE DISTRICT, CORPS OF ENGINEERS
P. O. BOX 1070
NASHVILLE, TENNESSEE 37202

IN REPLY REFER TO
ORNED-G

9 SEP 1981

Honorable Lamar Alexander
Governor of Tennessee
Nashville, TN 37219

Dear Governor Alexander:

Please be informed of the results of an inspection, under authority of Public Law 92-367, conducted on Akers Dam in Sumner County, Tennessee. An inspection team, composed of personnel from your Division of Water Resources, observed conditions which indicate a high potential for failure of the embankment dam due to questionable stability of both the upstream and downstream slopes and extensive seepage through the embankment.

Akers Dam is classified as a high hazard potential, small size dam and, as such, should be able to regulate at least a one-half probable maximum flood (1/2PMF) to conform to inspection program guidelines. A hydraulic analysis of the project's spillway showed that the spillway bank would be overtopped by the 1/2 PMF, directing flow onto the embankment. A visual inspection indicated that the stability of the embankment is questionable due to steepness of the slopes, undesirable growth on the slopes and seepage on the left side of the embankment.

Based on the results of the visual inspection, the dam is considered unsafe. While I do not view this as an emergency at this time, I recommend you initiate prompt action by the State to cause the owner to correct the deficiencies as soon as practical to minimize the risk to the residences located downstream.

A report of the technical investigation will be furnished your office upon completion.

Sincerely,

LEE W. TUCKER
Colonel, Corps of Engineers
Commander

CF:
Mr. Robert A. Hunt, Director
Division of Water Resources
4721 Trousdale Drive
Nashville, TN 37220

ORNED-G

NON-FEDERAL DAM INSPECTION REVIEW BOARD
PO BOX 1070
NASHVILLE, TENNESSEE 37202

Commander, Nashville District
US Army Corps of Engineers
PO Box 1070
Nashville, TN 37202

1. The Interagency Review Board, appointed by the Commander on 19 June 1981, presents the following recommendations after meeting on 27 August 1981, to consider the Phase I investigation report on Akers Dam, inspected by the Tennessee Department of Conservation.

2. The hazard classification should be changed from "significant" to "high".

3. The valve on the drawdown drain should be moved to the upstream side of the embankment.

4. A check should be made to determine if head loss in the emergency spillway channel would increase the reservoir level.

5. A volume check should be made of the inflow hydrograph of the 1/2 PMF AMC II routing to verify the computations.

ORNED-G
Commander, Nashville District
US Army Corps of Engineers

6. The Board is in agreement with other report conclusions and recommendations following minor revisions.

FRANK B. COUCH, JR.
Chief, Geotechnical Branch
Chairman

BOBBY G. MOORE
Assistant State Conservation Engineer
Alternate, Soil Conservation Service

EDMOND B. O'NEILL
Alternate, Division of Water Resources
State of Tennessee

THOMAS N. PORTER
Hydraulic Engineer
Alternate, Hydrology and Hydraulics Branch

EDWARD B. BOYD
Hydrologic Technician
Alternate, US Geological Survey

JAMES GUNNELS
Structural Engineer
Alternate, Design Branch

END

DATE
FILMED

1-82

DTIC